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ABSTRACT

These statements by 19 of California's government, business, and educational leaders address the need to adapt California's schools and colleges to the rapid changes occurring in the State's economy and society. They have a common theme: government, business, and educational initiative and cooperation are needed if California is to retain its economic strength and assure its citizens' economic well-being. Ideas for consideration from these statements include the following: expanding economic and job opportunities depends on continued leadership in high technology markets, industries, and innovations; school reform is needed; a strategic plan for economic and educational policies must be developed; marketing the State requires a partnership of business, government, labor, and education; caution is needed regarding optimistic views of the impact of high technology on the labor force; concentration on high technology is taking away attention and resources from basic industries; California's economy depends on well-educated citizens with particular expertise in high technology; collaboration between universities and corporations in basic research can be to the advantage of each and to the State's and country's economic benefit; and the government should make a strong commitment to public education. Thirty-four strategies for increasing high-technology manpower in the West are appended. (YLB)

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EDUCATION FOR CALIFORNIA'S CHANGING ECONOMY

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EDUCATION FOR CALIFORNIA'S

Observations and Suggestions from Nineteen Leaders

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CHANGING ECONOMY

of California Government, Business, and Education

CALIFORNIA POSTSECONDARY EDUCATION COMMISSION • 1983

On the cover: a printed circuit board -- the Intelligent Network Processor -- for the HP 3000 computer. Photo courtesy of Hewlett-Packard Company.

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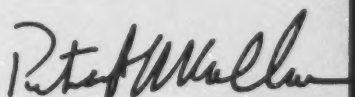
THE following statements by 19 of California's government, business, and educational leaders address the need to adapt California's schools and colleges to the rapid changes occurring in the State's economy and society. They have a common theme: government, business, and educational initiative and cooperation are needed if California is to retain its economic strength and assure its citizens' economic well being. The California Postsecondary Education Commission, the State's planning and coordinating agency for education beyond the high school, is publishing and distributing these remarks in hopes they will encourage this initiative and cooperation.

The authors of the statements discussed their ideas about education for California's changing economy at a conference held in Sacramento on May 3, 1983. The six sponsors of the conference were the Western Interstate Commission for Higher Education; the California State Department of Education; the California Business, Transportation, and Housing Agency; the Assembly Committee on Economic Development and New Technologies; the Joint Legislative Committee on Science and Technology; and the Postsecondary Commission. The sponsors of the conference are indebted to the 19 speakers for their participation in the sessions and for adapting and approving edited versions of their remarks for this publication.

The conference stemmed from the January 1983 publication of *High Technology Manpower in the West: Strategies for Action*, a report with 34 recommendations from the Western Technical Manpower Council of the Western Interstate Commission for Higher Education (WICHE) -- the interstate agency of the 13 western states devoted to cooperation among the states in providing high-quality, cost-effective programs to meet their education and manpower needs. Several of the statements in this document refer to these recommendations, which are reproduced as an appendix on pages 65-72 following the statements.

The statements range in length from the longest by John Young, who, as President of Hewlett-Packard and Co-Chairman of the Western Technical Manpower Council, delivered the keynote address of the conference, to brief comments by

Assemblymen Sam Farr and William Leonard and Senator Art Torres, who chaired its three panel sessions. Despite the diversity of these statements' length, they all contain thought-provoking facts and ideas for consideration by everyone concerned with the impact of education on California's economy.



Patrick M. Callan, *Director*
California Postsecondary
Education Commission

GEORGE DEUKMEJIAN

Expanding economic and job opportunities depends on our continued leadership in high technology markets, industries, and innovations.

Governor Deukmejian began his political career in 1962, when he was elected to the California Assembly from Long Beach. In 1966, he won the new Senate seat created for Long Beach under the one man-one vote decision, and in 1970 he became Senate Majority Leader. He authored more than 180 laws during his 16 years in the Legislature before being elected California's Attorney General in 1978 and Governor in 1982.

IT SHOULD be no secret to anyone that our goal of expanding economic and job opportunities depends on our continued leadership in high-technology markets, industries, and innovations:

- California's electronics firms employ nearly a half-million of our workers and provide over $6 billion in wages each year.
- High-technology industries have provided more than one-third of the total growth in the State's manufacturing employment since 1965 and can be counted on to produce over a quarter-of-a-million new jobs in the 1980s alone.
- All told, nearly one-third of all the electronic and high-technology equipment made in America is produced right here in California.

This is a proud achievement for our State, but we can no longer afford to rest on our laurels. Virtually every state in the nation is now targeting high technology as the key to solving its economic problems. At least 25 states routinely send re-

cruitment teams here to lure our companies and jobs out of California. Industrialized nations such as France and Japan, as well as developing countries such as Taiwan and South Korea, are also taking aggressive action to capture greater shares of our markets.

To help our companies and our workers compete, I recently proposed an Economic Development and Job Creation plan that I believe will contribute greatly to a more productive business environment in California. But what is often overlooked as an element in this environment is the importance of quality education. High-technology industries are extremely knowledge intensive. They are dependent on an ample supply of skilled technicians and engineers.

These requirements will increase drastically in the coming years. It's been estimated that by 1985 our high-technology industries will need 25 percent more computer scientists, 20 percent more engineers, and 18 percent more technicians.

The availability of a skilled work force is a key element in a company's choice of location. Clearly, if California is going to maintain its technological leadership, our educational institutions must redirect their resources toward greater emphasis on mathematics, science, computer, and vocational skills.

State government has an important responsibility in this regard. That is why I have recommended increases in funding for public education even at a time when we have a tremendous State deficit and when we're cutting virtually all other areas. The share of the total State budget devoted to education of our General Fund budget as we proposed it has been increased to more than 51 percent -- the highest level in four years.

In 1945, the conventional wisdom held that the worldwide demand for computers would be just ten units per year. Last year, more than 100 companies sold nearly three million computers. The development of those technologies and markets took vision, skill, and hard work by a partnership of the best and brightest minds in America -- many of them right here in California.

I want Californians to be the driving force behind even greater success stories in the years to come. I believe those achievements can be ours if we join together in efforts such as these to share ideas, to develop initiatives, but most important, to act quickly and responsibly with respect for our children's futures.

JOHN YOUNG

Reforming California's schools is more than a high-tech issue.

John Young has been President and Chief Executive Officer of the Hewlett-Packard Company since 1978. He is national chairman of Junior Achievement, Inc.; co-chairman of the Western Technical Manpower Council of the Western Interstate Commission for Higher Education; and a trustee of Stanford University. He recently served as national corporation chairman for the $300-million Campaign for Stanford.

AS THE leader of a fast-growing electronics company, I know the dependence of technology companies on the products of our educational system -- trained human resources. From the nationwide nature of our operations, I see states competing with each other to attract high technology, offering educational programs as an inducement. From our international operations, I am also keenly aware of the growing competition this country faces from nearly every major country -- each with well-financed programs aimed at achieving leadership in technology. And here again, education forms a key part of their strategies. If California is to attract industry -- or just retain

the growth from companies already established here -- it needs an educational system that can support and adapt to changing technology. But the strength of our schools is not just an industry issue. Our educational system affects the health of the entire State. If Californians are to participate fully in an evolving economy, then they must be prepared with the kinds of skills that will be needed throughout the economy.

THE CHANGING CALIFORNIA ECONOMY

Despite the difficulty of seeing far into the future, we can get some sense of where our economy will be in 1990 by seeing where it is today.

- Half of all the new manufacturing jobs created this decade will be in the high-technology field, where employment will grow twice as fast as the State average.

- The largest segment of employment will be in the services, which will grow just somewhat less rapidly than high-technology manufacturing, but many of those services with the most vitality -- information, financial, communication -- are based on new developments in electronics.

- Last year, electronics was the nation's seventh largest industry, in terms of dollar volume of sales. Extrapolating electronics' past growth rate into the future, it looks like electronics will be the nation's fourth largest industry by the end of the decade and, by the year 2000, second in size only to the health-care industry -- if we have enough capable people to staff it adequately.

- Earlier I mentioned that half the manufacturing jobs created in California during this decade will be in the technology fields. Economists have a concept used in job projections called the "multiplier effect," which means that for every new manufacturing job, a certain ratio of support jobs are also created. Applying this concept to high technology, State planners have projected that "high tech" job growth could account for 40 percent of total job growth in this decade. That's a lot of leverage.

I am not trying to portray "high tech" as a panacea for all the ills of our economy or as a cure-all for unemployment. No single industry -- no matter how healthy -- can create enough jobs to absorb those lost in basic industries hurt by international competition or by technology changes that allow us to produce more with fewer people. Nonetheless, even though it's not the only game in town, high technology will be the prime determinant of whether the California economy continues to grow faster than the rest of the nation, and indeed how well our nation will prosper in the world-trade arena.

In this regard, one fact about technology-intensive industries should not be overlooked: They are highly mobile. They have no geographic constraints. A recent study done for the Joint Economic Committee of Congress ranked the factors used in determining where high-technology firms would locate. The one cited as most important was a skilled work force. Reforming our schools therefore becomes a key business development issue.

While education is a very strong consideration for firms like Hewlett-Packard, I believe we need to broaden our view about why we want to strengthen California's schools by considering why society educates its youth.

One role of education is to prepare our young to be productive members of society. That means skill training: preparing people to earn a living. But there is a second role of education, and that is to prepare people, regardless of their eventual career choice, to understand the society in which they live. In this broader context, education's role is to prepare people to adapt to change, and to alter their career directions if they so desire.

Whether we view the role of education as vocational or sociological, philosophical or inspirational, we probably all agree that those two roles point to the need to provide our young people with a solid background in basic skills.

Like education, high technology also has a dual nature. It is an industrial segment that is science based and that relies heavily on highly trained people, but it is also a tool that can be used in *any* industrial and service segment to increase its

competitiveness. The Japanese understand this leverage factor perhaps better than any other nation.

Our educational system is layered in a way that reflects both purposes of education and the dual nature of high technology. Our primary and secondary education system, with its goal of preparing youth to understand and adapt to their world, must help them understand the technology that is affecting their society. The focus of our postsecondary system is primarily on career preparation, and problems at this level most directly affect industries that are technology intensive. Let me comment on the problems we face in both of those arenas in that order.

CHANGING THE SCHOOLS

We should keep in mind the fundamental role of primary and secondary education -- making our society understandable -- as we formulate changes in the schools. If we do not have a firm consensus on *why* we want our young to be technically literate, we risk becoming superficial or trendy in our approach to problems.

We could put a computer in every school, but it would accomplish very little if the program was not integrated carefully into a strong foundation in curriculum.

A number of legislative reform proposals for education address the most crucial problems we face. One reform element I heartily embrace is raising entrance requirements and increasing the amount of instruction time. California doesn't stack up well in these categories. Compared to students in the New England states, only half as many Californians take three or more years of math. Our students are about one-third as likely to take three or more years of science.

A high school graduate with just one year of math and one year of science -- the minimum requirement in too many districts -- has effectively precluded the possibility of pursuing a technical career or one even close to the real heart of a technology company.

Fifteen years old is just too early to have closed off that option, and increased graduation requirements would help keep these

doors open a bit longer. Alarmingly low percentages of minority students take more than minimum graduation requirements, and raising those standards would help keep their career options open a little longer. Programs like MESA -- Mathematics,Engineering, Science Achievement -- that Richard Collins describes elsewhere in this volume, aim at interesting minority students in technical careers. Raised requirements for graduation would provide some encouragement for those efforts.

Reforms addressing the issues of teacher training and compensation are vital too. According to the National Science Teachers Association, last year fully 84 percent of the newly employed math and science teachers in the West were unqualified to teach their subjects.

That fact shouldn't surprise anyone. Compared to the pay of other comparably trained professionals, teaching salaries are abysmally low. Again, here is a problem industry can't solve. The support -- or lack of support -- for education is a reflection of our priorities as a State. We rank seventh in the nation in regards to the amount of taxes paid by each California resident. You might think we'd therefcre rank seventh in regards to how much we spend to educate each public school student. We don't. We rank thirty-eighth in the nation on that measure, and if you look at the percentage of our personal wealth we spend on education, we rank even lower -- dead last in the nation.

There's a lot industry can do to mitigate this problem. Equipment donations can help, but they need to be buttressed with close involvement in local schools. In the Sacramento area, for example, the Roseville Division of Hewlett-Packard has developed a two-semester course in computer literacy for students in kindergarten through high school. When we recently granted a number of personal computers to California high schools, we made sure to appoint a Hewlett-Packard employee as liaison for each school and a corporate staff member to coordinate curriculum development. It's going to take that kind of industry involvement just to fill in the gaps.

Again, I have to stress that industry can only mitigate the problems that the schools face. The fundamental solutions --

increased support, increased expectations -- will have to be found in a wider arena. Education is a reflection of our collective priorities, which means that decisions will have to be made through the political process.

CHANGES IN COLLEGES AND UNIVERSITIES

At the postsecondary level, the most critical problem is the fact that our colleges and universities simply cannot respond to the growing number of young people who want to pursue engineering careers and are fully qualified to do so. This poses a real problem for those of us in industry. Two years ago, an American Electronics Association survey demonstrated a significant shortfall between the number of engineers its member companies would need and the number of engineering graduates our colleges and universities could be expected to produce.

There is no shortage of young people wishing to study engineering, but there is a desperate shortage of university faculty, especially in high-growth fields like electrical engineering and computer science. Low faculty salaries and obsolete equipment have combined to make university teaching much less attractive than it used to be. A new graduate with a bachelor's degree can earn as much in our company as an assistant professor with a Ph.D., and we can provide them more up-to-date equipment. Not a great return for four additional years of education.

Since industry is part of the problem, we have tried hard to be part of the solution. That's the impetus for faculty development programs like the one co-sponsored by Hewlett-Packard and the American Electronics Association where, because Hewlett-Packard has been so concerned about the faculty shortage, it will spend $6 million over the next five years just to support 50 Ph.D. candidates who will go on to teach at the university level. Industry is also exploring ways to loan people to teach at the university level, establish endowed chairs, initiate joint projects and shared research facilities, and donate equipment.

Industry can and is doing a lot. But governmental action is essential for a long-term solution. Faculty salaries must be

raised, and there must be increased investment in the equipment needed for first-class research and teaching. The decision by the University of California to raise engineering faculty salaries is a step in the right direction. Legislation should also be passed to encourage equipment donations from industry, and should include both software and maintenance costs.

We will also have to re-examine our assumptions about higher education. Right now, many people assume it's an activity we do at a certain time of our lives and then move on to other things. Technology is simply changing so rapidly that we can no longer afford that assumption. Some of our training people estimate that the half-life of an engineer is five years. Without continuing education, people will become obsolete, and that is a waste we cannot and should not afford.

Our postsecondary education system needs to adopt lifelong education as part of its charter. This will mean new ways of delivering education, such as televised or computerized instruction. We have engineers at Hewlett-Packard living in Massachusetts who are pursuing their master's degrees in engineering from Stanford through a program of tutored videotape instruction. The results have shown them to be doing better than students who are physically sitting in the classroom. Our engineers in Roseville can take courses by means of a live television link with the University of California at Davis and Chico State University. These programs deserve emulation.

Again, as the agent of change, industry has a contribution to make toward continuing education. We are willing to make that contribution. We can and should pay the full cost of the program for our employees involved. We can also help by making our facilities and people available for instruction.

But before we can make that contribution, our postsecondary system must recognize that the need for education is not confined to a certain time of life, nor even to a certain parcel of land called a campus. We need to expand our goals beyond producing skilled people. We should be looking for ways to

maintain the skills of the graduates we have produced and to facilitate professional retraining.

FUNDING REFORM

The question of how to fund educational reforms such as those I've advocated here is no doubt going to arise. Some people will advocate creating new revenue sources. Others will argue that a reallocation of our existing resources is all that is needed. Both strategies may be appropriate. The business community certainly believes that education is a good investment.

However, as we address the revenue issue, we should also remind ourselves of that wide disparity between our level of taxation -- seventh in the nation -- and our level of support for education -- thirty-eighth. That disparity says something about how we as a State rank education as a priority. We've chosen to spend our revenues on other things. Some realignment in our priorities may be in order here, too.

We need to reform California education not because high tech needs it or because we see a particular kind of industry as a cure-all for our unemployment problems. Such an approach would only lead to expectations for an overnight cure and disillusionment, since it isn't likely that a quick fix will come about.

Instead, we need to recognize that the world is changing and that our expectations about education need to change with it. As a nation, we are no longer able to rest on our technological or economic laurels. The reality of foreign competition is too real to permit such apathy. What will our children have to market in the world economy? We are faced with growing competition from countries with lower living standards and costs. We must either work harder, cheaper, or smarter than our foreign competition. I know none of us is opposed to hard work, but I'd rather we leave our children the option of working smarter. And that requires an investment in education that is long overdue.

JOHN GARAMENDI

This is the year for us to move boldly with educational issues in California.

John Garamendi was elected to the Senate in 1976 and re-elected in 1980 in the 13th District that ranges from Lake Tahoe to Mammoth Lakes. As the Senate's Majority Leader, he is responsible for guiding his party's legislative program through the upper house. He has served on the Senate Education Committee and presently serves on five other Senate committees, including Finance.

THE IMPORTANCE OF STRATEGIC PLANNING

FROM my perspective in the State Senate, it will not be sufficient to talk about the problems of education without relating them to the larger state and world situation. We need to look at where California is now and where we should be headed, not just in regard to education or high technology, but also in relation to the national and world economy. This requires the Governor and Legislature of the State to engage in strategic planning. I know that many corporations and some universities engage in such large-range planning. But this great State of California does not do any -- at least not yet.

We must know what resources are available to us, where we should apply such resources, where our greatest potential lies for social and economic growth, and what our strengths and weaknesses are. We know about our unique advantages in aerospace and electronics research, but what about our declining industries? Are there ways we can help revitalize the auto industry? Or, is the industry sick for reasons that the State can't deal with? With the answers to questions like

these we can develop a strategic plan for the economic and educational policies which can help the State of California to prosper.

State government is the essential place for this kind of strategic planning to begin. We may never end up with a formal plan as such, but at least the Governor and legislative, business, and other leaders in the State should be thinking about the ways that social, economic, and educational issues fit together. Sacramento is the place for this process to start.

In any strategic plan, we will undoubtedly find that high technology is one of the key elements in California's future economy. Not only is it a growth industry in the State, but other industries in California, such as agriculture, that up until now have not been considered to be relevant to high technology, are growing increasingly dependent on new technologies for their well being. I have spent my life in agriculture, and I represent a large agricultural district. I know that agriculture is using some of the most advanced technological innovations available -- from genetic engineering to photosensing devices for picking and sorting fruits and vegetables.

THE NEED FOR GOVERNMENT LEADERSHIP

In developing a strategic plan for the State and recognizing the role that high technology plays in the State's economy, our first priority must be to recognize that there is an appropriate, legitimate, and critical role for government in advancing the economy. Anyone who has studied California's history knows just how essential government has been to this State's development. Those who say government has no role in stimulating a better economy, or that the best government is the least government, are ignorant of California's economic history. Consider where we might be in this State if government had not involved itself in agriculture policy which helped nurture the State's single largest industry. Without the aid of government, agriculture in California would consist largely of dryland grain farming and cattle raising. With no federal reclamation projects, no California Water Project, no cooperative extension, and no agricultural research of the University of

California, diversified agriculture, as we know it, would not have become our greatest economic resource.

Similarly, today we can talk about the role that government has played in the growth of our high-technology industry, through its support for research and development. A creative government can stimulate the economy through research, education, practical applications of research, and infrastructure development by assisting and helping implement growth and reform.

A creative government can also be especially helpful in implementing a society's educational goals. The report of the Western Technical Manpower Council of WICHE, *High-Technology in the West: Strategies for Action*, points out many of the critical elements for enhancing the educational system. I would guess that 75 percent of the strategies it identifies are now moving through the Legislature in specific legislative bills. For example, legislation to enhance education from kindergarten through high school, introduced in the Assembly by both a Republican and a Democrat, and in the Senate by Senator Hart, embody basic elements of these strategies in raising standards, upgrading the teaching profession, and improving teaching. To combat the lack of academic standards in the high school curriculum, the legislation sets graduation requirements for mathematics, science, English, and social studies, as well as computer literacy and exposure to the fine arts. We must once again reassert that mediocrity or minimum standards are not appropriate in California. Instead, we must set higher standards, recognizing that although not every school and every student will achieve them, everyone should strive toward them.

THE NEED FOR MORE RESOURCES

When talking about education, it is hypocrisy to speak of improvement without speaking of spending more money. Education is in competition for State funds with other social programs, and there is not enough money to pay for enhancing the educational system without also trying to control the costs of the medical and social welfare systems. Several years ago, we started a program to control health costs and legislation

enacted last year has created a whole new economic structure for health care. We have to maintain those reforms by seeing to it that those laws remain on the books because without them, we will continue to see the inflation of our State medical bills. By controlling these costs, we will be able to redirect scarce State resources toward improving education.

Finally, while the basic focus of the Legislature at the moment is on elementary and secondary education, we cannot put higher education on the back burner for a year or two because we lack adequate funds. This means that we are going to have to raise taxes to improve the whole educational system. These increases in taxes must be linked directly to the reforms that are embodied in the major bills moving through the Legislature. We should not, and cannot, have one without the other. The taxes to be chosen should be wide ranging, touching every element of our society, including corporations, consumers, and those who enjoy significant tax loopholes. Thus I take great exception to the Governor's proposal to wait for new funds. Our kids cannot wait. Our educational system cannot wait. The economy of the State of California cannot wait. I agree that the economy will improve, and that there will be additional revenues in the future. But those revenues will be in heavy competition for all kinds of programs. So this is the year for us to move boldly to deal with educational issues in California. This is the year in which we must grab our opportunity to make the needed reforms, raise the revenues to put our educational system on a solid financial basis, and begin to provide our economy and society in California with the means to meet the challenges of the future.

•

KIRK WEST

Marketing the State requires a partnership of business, government, labor, and education.

Kirk West is Secretary of the Business, Transportation, and Housing Agency and also serves as a member of Governor Deukmejian's cabinet. He has served as Executive Vice President of the California Taxpayers Association, Chief Deputy State Controller, Deputy Director of the State Department of Finance, and as Assistant Secretary of Resources.

SOME 200 bills have been put into the legislative hopper in California this year dealing with economic development, including various measures to market the State both as a place for our own businesses to stay and also as a place that welcomes businesses from other parts of the country. We have to let these firms know that we want them here. Other states have very aggressive programs to try to attract employers, and many of them can offer attractions that are illegal in California because of our prohibition against gifts of public funds to private entities, such as offering tax abatements, buying property for firms, or buying common stock in these firms out of public funds. Despite their competition, we have major advantages to offer, among them, our geographic position on the Pacific rim, our large and affluent population of twenty-four and one-half million residents, and our college and university systems. But we need to market these advantages aggressively in several ways:

- First, we must avoid *negative* signals that would discourage new and expanded businesses. Besides removing any sem-

blance of possible past disinterest in industrial growth, we have to avoid new negative factors such as rent control legislation that inhibits the development of affordable rental housing, or punitive plant-closure legislation that, while well-intentioned, would act as a disincentive in attracting business. The leaders of high-technology industries share similar interests with those of all industries: They want a tax and regulatory climate that will let them thrive; they want affordable housing for their employees; they want adequate transportation facilities; and they want some predictability in State policies toward business and industry.

- Second, beyond avoiding mistakes, we can expand our positive attractions. Job training is critically important here. Already the State has about 30 different job-training programs on the books and expenditures, including vocational education, of about $1.8 billion. But in the past, much job training was ineffective because we trained many people for jobs that did not exist. Here is where marketing the State requires a partnership of business, government, labor, and education. Without such a partnership, as illustrated in the new Joint Job Partnership Training Act with the development of "PICs" -- Private Industry Councils -- at the local level, we will not have successful job training programs. The key factor here is greater involvement of the private sector in helping train people to move from industries that are declining to those that have a future. But also important is better communication between business and education, in order to avoid sometimes conflicting signals. For example, simply putting a computer in every classroom will not necessarily do the job of developing computer literacy. In and of itself, it could become only a fad. Computers can be used for more than teaching computer programming; they can aid in teaching general basic skills.

- In addition, we can end the division that has developed in life between the world of study, which traditionally lasts until 18 or 21 years of age, and the world of work, until age 65, which abruptly ends in the world of retirement. These three segments of life need not be completely separate. The artificial barriers between them can be eliminated, and here

business and education must also work together to encourage lifelong, continual renewal and learning.

Just putting more money into the school will in and of itself not make any appreciable difference in these directions or in expanding students' basic skills and attitudes, including academic skills, an adaptability to change, the ability to compete in increasingly competitive programs, good citizenship, a work ethic, and the concept of providing an adequate day's work for a day's pay.

The Governor has made school reform one of his very top priorities, but it is important that reforms be accomplished economically. Additional funding for the schools will be a high priority for our future economic growth, but because of our present financial problems, to have any kind of major increase in taxation now would create difficulties for our economy and our ability to compete with other states. Much can be done, I believe, by redirecting existing resources and emphasizing higher standards. We have an average school year of 175 days, for example, compared to about 220 days in Japan. We have a shorter school day than many other states. As a result, our students have had about a year less school by the time they graduate than the average U.S. student outside of California.

Bipartisan interest exists in the Legislature for upgrading the schools, strengthening their curriculum, and preparing California students better to enter the work force and meet changing conditions. These improvements are also an extremely high priority of this administration. They will require not only bipartisan cooperation in government but also cooperation between government, business, labor, and education. If we do not learn to cooperate, we won't be able to compete with countries that have mastered the art very well.

HENRY LEVIN

Caution is needed regarding optimistic views of the impact of high technology on the labor force.

Henry Levin is a professor in the School of Education and the Department of Economics as well as Director of the Institute for Research on Educational Finance and Governance at Stanford University. The author of over 100 scholarly articles and the author or co-author of eight books, he is a former Fellow of the Center for Advanced Studies in Behavioral Sciences at Stanford and a Research Associate in the Economic Studies Division of the Brookings Institution in Washington, D.C.

I AGREE wholeheartedly with the move toward improving basic skills -- not only basic skills in mathematics and science but also in reading, writing, speaking, and listening -- the last of which has become virtually a lost art in America. I also agree that serious problems exist at the college level in terms of shortages of faculty, equipment, and funds, and I concur about the importance of so-called "life-long" or "recurrent" education and about the desirability of recurring periods of work, education, and even leisure throughout life. We haven't dealt with this concept adequately as yet in our educational institutions, and we cannot leave it to haphazard development.

But I believe caution is needed regarding optimistic views of the impact of high technology on the labor force, and thus I would like to inject several cautionary notes into the discussion of this issue. Even though I'm a high-tech freak, and

despite my enthusiasm about a high-tech future, my research and that of my colleagues at Stanford's Institute for Research on Educational Finance and Governance point to some possibly disturbing consequences of high technology for employment.

A LIMITED NEED FOR HIGH-TECH SKILLS

The first follows up John Young's statement that half of all the new manufacturing jobs created during this decade in California will be in the high-technology field. This means, however, according to the California Department of Economic and Business Development, that only about 8.5 percent of all new jobs in California will be in high technology. And based on U.S. Department of Labor data about high-tech industries, only about 20 percent of these new positions will be in scientific, technical, or professional areas such as computer sciences, physical sciences, or engineering. So in terms of high-tech jobs in high-tech industries, we are talking essentially about 2 percent of California's new jobs during this decade. Therefore, despite our enthusiasm about high technology, we have to bear in mind that we are talking about a very small proportion of the labor force, and we must ask ourselves about the rest of the labor force, both in high-tech and other industries.

From the analyses that we have done of changing skills requirements in the labor force, we are not optimistic that there will be a large demand for skilled workers generally in the economy. For example, after looking at job category after job category in terms of the skills that they require, we are finding that the tendency is to apply new technologies in areas of scarce and expensive skills, rather than in minimum-wage skills. Thus robots are not being used to replace manual laborers, even though many people assume that they are being employed to reduce human drudgery. Instead, they are being used to replace industrial operatives whose positions are much more costly to industry.

In this regard, it was significant, I believe, that when President Reagan was offered a vita by a former steel worker dur-

ing his visit to the Control Data Institute in Pittsburgh earlier this year, the computer repair job that the man got as a result of the President's leverage pays about half of what his old job did in the steel industry and involves far fewer skills than it did five or ten years ago. It turns out that this man now needs little information about circuit logic, design, or diagnostics, because most of his repair work is determined by plug-in equipment which tells him what circuits or functions are not running properly and then indicates what he is to do with it -- which is generally just a change in a plug-in module. And, as you can imagine, there aren't very many of these jobs available to unemployed steel workers. As a postscript, it is instructive to note that the man could not support his family of four and make house payments on his home, with the $6-an-hour wage, so he lost his home. Fortunately he was recently called back to his original position in the steel firm.

BOOMS AND BUSTS IN ENGINEERING

I believe we also need to be concerned about the current expansion of engineering enrollments. Studies of manpower supply and demand over the past 35 years have shown that engineering is characterized by a boom-and-bust cycle, in which shortages of engineers first occur, then salaries go up, students learn about the shortages and the high salaries, enrollments increase dramatically, and the new students graduate, only to find that some of the expected jobs are not there, after which the market goes down again. Thus a tremendous engineering boom occurred in the late 1960s, fueled largely by increased military expenditures and the development of new weapons systems; but by 1971 many engineers were unemployed, with the predictable consequences that engineering enrollments dropped drastically. The fact that there is a "gestation period" or lag between when enrollments increase and when we actually get new engineers results in this boom-and-bust cycle.

The problem now is that we are expanding engineering enrollments very rapidly, even though signs are already evident that the market may not exist for this expansion. Placement centers in California colleges and universities report that en-

gineering graduates are getting only about half of the offers this year that they got last year, and that petroleum engineers are waiting in line for their first offer, despite the fact that four or five years ago we were told that we should expand our output of petroleum engineers significantly. The 1983 Endicott Report on hiring of college graduates estimated a decline of 35 percent between 1982 and 1983 in the number of new hires of college graduates with engineering degrees.

THE FICKLE ROLE OF THE FEDERAL GOVERNMENT

One other element in this problem is the fickle role of the United States government. About 25 percent of scientific and technical personnel in the United States are employed directly or indirectly by the Pentagon. If the next few years bring the massive increases in military hardware purchases that the President seeks, the resulting increase in the demand for engineers, scientists, and technicians will in the long run exacerbate the boom-and-bust cycle. The immediate shortages will soon be filled by new graduates, but as soon as we get over this immediate cycle of spending on hardware, the bust in employment of these workers will be more serious than any we have yet seen. Meanwhile, the boom in military hardware will affect very drastically the availability of scientific and engineering personnel for high-tech developments on the civilian side.

THE IMPACT OF FOREIGN COMPETITION

Many people believe our most serious problem in high technology stems from the competition of foreign firms, such as French or Japanese companies, moving into this market. In terms of the American labor pool, however, the major problem turns out to be American firms expanding their production outside the United States -- in Indonesia, Malasia, Hong Kong, Taiwan, and other countries. The vast changes now occurring in the technology of production mean that these firms are able to produce high-quality electronic chips, for example, with fifth-grade labor in some of these countries. How we

compete in these situations by making our own children smarter is a puzzle, since essentially the production operations are built into very sophisticated manufacturing processes that require no more than a highly disciplined work force to monitor the processes without requiring a great deal of brains.

I note these problems as puzzles that require further analysis than we have yet given them. But I will close by pointing to one problem that needs action more than analysis: the education of minority children in California. This is going to be the most serious problem in California education at all levels during the rest of this century. By the end of this decade, a majority of children in California's elementary and secondary schools will be minorities, many of them coming from families where English is either not spoken or is not the principal language. So far, there is very little movement at any level of education in the State to deal with this phenomenon, and yet action on it is imperative. We should be asking whether those minority students who should be in the top 12.5 percent of high school graduates and eligible for admission to the University of California are getting the proper education and preparation for higher education in their schools. For those of us who may be more worried about the labor force than about higher education, we should be concerned about what happens when children grow up, since they become the labor force of the future. If we are not concerned about them now -- if we simply wait to find out what happens to them -- we are going to get a very unpleasant surprise which really shouldn't be any surprise at all.

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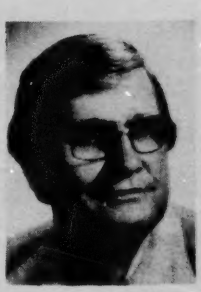
HOWARD OWENS



Our concentration on high tech is taking away attention and resources from making ourselves competitive in our basic industries.

Howard Owens, past President of United Auto Workers, Local 645, is currently serving as International Representative of the United Auto Workers. He was recently appointed the UAW's Community Action Program Representative and continues to coordinate UAW's Job Corps and CETA Manpower Programs.

I WORRY that high tech may become one of those fads that we look to to solve all our economic problems, since I don't believe that it will. The only way we are going to meet these problems is to consider the overall economy of California broadly enough to make sure that it continues to work. Our concentration on high tech is taking away attention and resources from making ourselves competitive in our basic industries -- our "smokestack" industries. These industries have been disappearing, yet they can be revitalized if they receive investment, good management, and education.

One of these industries is automobiles, and I know it best because I have been in it all of my adult life. California's initial auto industry, based on shipping frames and parts of a limited number of vehicles here for assembly and sale on the west coast, made good economic sense because it was cheapest to do it that way. But as more and more models were made, we got to the point that each plant made only two or three kinds of car, only a few of which were sold here while the rest were shipped all over the country -- compounding the transportation costs and destroying the reason for which the plants were built in the first place.

Today, the most successful people in the auto business are the Japanese, among other reasons because they have put their stamping and assembly operations side by side, and they have few enough models so they can see all of them in the area where they are made.

If we concentrated on revitalizing our industries like automobiles, we will also revitalize steel, glass, rubber, and other industries. We also reduce the need for retraining displaced workers. Retraining auto workers like the General Motors employees laid off in Fremont and Southgate, and trying to channel them into other kinds of jobs such as high tech, not only requires long periods of schooling, it means going from a $12-an-hour job to a $6-an-hour job. Meanwhile, the high-tech companies are flaunting a very anti-union bias and in some cases violating the law to keep employees from organizing into unions so they can earn a decent living. At the same time, they are shipping jobs for the kind of people that I represent to Mexico, Japan, and other countries. And the young people coming out of inner-city areas of Los Angeles and the Bay Area who can't fill out forms and in some cases can't sign their names -- even with a high school diploma -- are not prepared to meet the demands of high technology.

For all these reasons, despite the importance of high tech, we must concentrate on other industries to develop a balanced California economy.

ANN PIESTRUP

We can offer unprecedented learning opportunities to our children through the technology we are creating here in California.

Ann Piestrup, founder and chairman of the Board of The Learning Company, is an authority on the application of microcomputers in childhood learning. She earned a doctorate at the University of California, Berkeley, and has been a Research Associate with RMC Corporation and the American Institutes for Research.

I REPRESENT a small company -- The Learning Company -- with 20 employees, 18 of them women. We think we offer a special vision of how high technology can relate to education, and that is what I'd like to share with you.

Fifteen years ago, I was a fifth-grade teacher in a poverty area of Buffalo, New York. The school had boards on the broken windows, very few books or other learning materials, and a history of failure. When I spoke with the children about taking pride in the school, there was laughter among my students. I felt determined to find a way to offer more to these children and others. I went to graduate school to learn more about what happens when a child is actually learning, then spent ten years carrying out government-funded research projects nationwide.

I found some very effective techniques for delivering instruction, but I also found that these often did not reach children. When personal computers became available, I saw them as a unique new vehicle to deliver superb learning environments -- not just for learning the new skills needed for the computer age, but also for learning the mathematics and com-

munication skills that students have needed to function in an industrial society.

In 1979, I started The Learning Company with a grant of one computer and $1,000 from Apple Computer's Education Foundation. I explored what the computer could do with colorful graphics, music, and voice, but soon found that effective learning programs were very expensive to develop. The National Science Foundation and the National Institute of Education then awarded a grant that allowed me to hire people who had published widely, a mathematics educator and an expert videogame designer and programmer. By the end of the year, we had a new genre of software products to show Apple, Atari, and other hardware companies. Fifteen months ago we attracted venture capital and began marketing our products. Now we are offering software that teaches computer-age thinking skills: software that very young children can use, but which challenges graduate students in computer science.

Using the computer, children can do much more than was ever thought possible in the past:

- We have children doing problem solving, strategic planning, formulating and testing hypotheses in playful learning games -- and I mean children in the barrios and the ghettos, as well as the children whose parents can afford computers.

- We have software that can help children learn to think logically -- with analogies, sequences, negation, matching, and noticing differences.

- We have four-year olds plotting their own original computer graphics after learning numerals, number lines, arrays, and plotting conventions.

- We have seven- and eight-year olds designing their own computer logic circuits using electrical engineering symbols that change colors to indicate their logic state.

• We have second and third graders plotting three-dimensional graphics -- flipping, spinning, and rotating the figures that they create as possible elements in their own videogames.

• We hear of fourth- and fifth-grade children playing VisiCalc and Wordstar as if they were games.

We can start at the youngest levels to prepare children -- and particularly girls and minority children -- to develop the thinking skills that they will need in the future. If we wait until college, it will be too late. The kids are ready now, and they are able to use the technology.

It is a start to give a computer to each school, but more than that is needed. Beyond hardware, superb software is needed to help deliver instruction where it is lacking and offer a transformation of what's possible in learning. The critical thing is that we actually do the things that we're talking about. This will take leadership from all of us. We can't leave leadership to other experts, thinking that it is someone else's responsibility. It has to happen here where the technology is developing, and if we want to make superb education our priority, we can achieve it.

New skills are needed by our children. Skills in abstract thinking and problem solving have never been more important. We can offer unprecedented learning opportunities to our children through the technology we are creating here in California.

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SAM FARR

We have an opportunity to demonstrate that we are at the forefront of resolving the issues facing our country.

Sam Farr was first elected to the California Assembly in 1980 and then reelected in 1982 from the 28th Assembly District that includes Monterey and Santa Cruz. He chairs the Assembly Committee on Economic Development and New Technologies and serves on the Joint Committee on Science and Technology, the Select Committee on Small Business, and three Assembly Committees.

WHEN I was a Peace Corps volunteer in the barrios of Colombia, where people were illiterate, almost everything they mentioned about the United States had either originated in or was related to California: our movies, our quality of life, our coastline, our freeways, our educational opportunities, and our work climate. These features of California are known the world over, and my feeling was that if I was going to be on the forefront of change in the United States, the best place to be was in State government in California. That's the reason why I'm in politics and in the Legislature.

California is a nation-state, and as a nation-state we have an opportunity that few other states have to demonstrate that we are at the forefront of resolving the issues facing our country and showing the world what is so great about American life. Those who are elected to public office are called on to resolve these issues. We can't resolve only one problem; we have to deal with all of them. But we in the Legislature are generalists. This is why we need everyone with ideas and experience in education and understanding of high technology to be part of the solution process. We need you to use your in-

terest in helping solve the job problem through training and retraining. We need your ideas about improving health care delivery while cutting its spiraling cuts -- the most inflationary costs of government today. We need your expertise in preparing young people for the rapid changes ahead, to increase the quality of life still further in California, to continue to attract business to the State, and to maintain California's place in people's thought everywhere as the exemplar of America.

ART TORRES

We need a new industrial policy for California: one that incorporates the best of smokestack industry, high technology, and education.

Art Torres was first elected to the Legislature in 1974 and in 1982 was chosen to represent the 24th Senate District of Los Angeles. In the Assembly, he chaired the Assembly Health Committee and the Subcommittee on Medi-Cal Reform. He is a member of the Senate Education Committee and chairs the new Joint Committee on Science and Technology.

WITH the creation of the Joint Legislative Committee on Science and Technology which I chair this year, the California Legislature has publicly acknowledged the need to think be-

yond short-term crisis-oriented legislation and focus on long-term strategies and agendas for the State and the long-range implications of State policies.

These strategies and agendas include the appropriate responsibilities of both government and industry in assuring an adequate supply of technically trained persons; appropriate action by government, industry, and education for solving problems posed by technological progress; and the appropriate role of two-year and four-year colleges and universities in retraining workers -- a problem that affects my district of central Los Angeles particularly, since 47 percent of displaced workers from plant closures are either Black or Hispanic.

This year we are working very closely at the national level with Senators Kennedy and Byrd, who have established a national task force to develop a new industrial policy for America. I think that we need a new industrial policy for California as well -- one that incorporates the best of smokestack industry, high technology, and education. We cannot look only to one of these resources as the total answer to the challenges that we face; instead we must look to all of them in addressing the problems generated by our progress from an industrial to a computer age.

PAT HILL HUBBARD

We do not need to be as concerned about caution as about inaction.

Pat Hill Hubbard is Vice President of the American Electronics Association, where she is responsible for a nationwide program to address the shortage of engineers. She also serves as the President of AEA's Electronics Education Foundation and on the Board of Governors of the California Community Colleges.

AS Vice President for Engineering Education of the American Electronics Association (AEA) and a member of the WICHE Western Technical Manpower Council, I believe major changes are needed in technical education in California if we are to meet the needs of our high-tech industry for skilled employees.

ENGINEERING AND TECHNICIAN NEEDS THROUGH 1987

The needs of the high-tech industry remain strong, despite the recent economic downturn. AEA's latest national Technical Employment Projections survey of a sample of 815 companies, to be released in July, found that nationally companies project an *annual* compound growth rate through 1987 of 10.6 percent for electrical engineers, 16.5 percent for software engineers, and 15.7 percent for electronic technicians. If the needs of the 405 California companies that responded -- a total of 5,071 electrical and computer engineers by the end of 1983 -- are juxtaposed against the 3,620 engineering graduates in these fields that all of California's colleges and universities produced last year, we come up with an annual shortfall of 1,451 engineers. And AEA has over 1,200 member companies in

California alone! Nationally, we are projecting a shortfall of some 20,000 electrical and computer engineers a year through 1987.

The need for engineers and technicians is clearly here. The question involves the responsibility of industry and government to ensure that an adequate supply of graduates is available to meet this need.

INADEQUACIES IN HIGHER EDUCATION

The cause of our inadequate supply of graduates is not a lack of competent applicants. Instead, currently one out of every three students is denied admission to engineering study. In California, for example, among the 13 campuses of the California State University system that offer engineering, six will be "impacted" in engineering in 1983-84, meaning that they will likely receive more applicants in the first month of admission than they have capacity to fill for the entire year and will therefore restrict admission in these programs to the most highly qualified applicants.

Their problem is a lack of educational resources to accommodate interested and qualified students -- in particular, lack of faculty and of laboratory equipment. While we need 1,000 new engineering faculty nationally every year, we produce only 450. One California State University campus has been unable to fill one-third of its full-time engineering faculty positions because of the State University's low starting salary of $19,044. The low State University salaries -- lower by nearly $4,000 than public colleges in the Southwest, averaging $22,896 for assistant professors, compared to their $26,592 -- do not attract any but the wealthy, those who have married well, or those who, like religious converts, have given up all worldly goods.

Laboratory equipment is outdated, and little is available to teach new technologies. A recent study of equipment needs in engineering and electronic technology programs at 67 of the State's 106 Community Colleges concluded that they need $13 million to upgrade their laboratories. For all 106 colleges, the cost may well be $20 million. At the State University, funds are available to replace less than 2 percent of instructional

equipment annually, resulting in a 59-year life cycle for this equipment. Thus San Jose University reports that over 80 percent of its teaching equipment in engineering is 20 years old or older.

These faculty and equipment shortages illustrate why California's colleges and universities are unable to expand capacity to meet the needs of the State's high-tech industry.

ROLES OF INDUSTRY AND GOVERNMENT

Industry is already responding to this problem. Two years ago, AEA established a goal for each of its member companies to give 2 percent of its research and development expenditures to engineering education. It also established corporate-level industry committees throughout the country that has raised $2 million since January 1983 through AEA's Foundation and another $142,031,901 through direct grants from companies to universities. Our goal is to raise another $2.5 million by the end of 1983. In California, AEA companies have funded 18 fellowships to provide fellowship loans to U.S. citizens to pursue graduate study and eventually teach electrical or computer engineering.

What, then, is government's role? Historically it has been to provide budgetary support as well as guidance of educational resources. Our position at AEA is that government should be a catalyst to encourage the partnership between industry, education, and government. One way to go about this is to enact positive tax policies that encourage companies to invest in education -- as exemplified by Assemblyman Jack O'Connell's AB 430, that would provide tax incentives for companies to donate new equipment to California colleges and universities. Other ways are to increase salaries for engineering professors in public universities and adequately support Community Colleges as the basic occupational training and retraining units of the State.

In an effort to improve Community College training and retraining, however, we must be concerned that we don't restrict these colleges by giving people least likely to have had experience with technical education control over curricular decisions or by starving basic funding for these institutions.

New groups, such as Private Industry Councils, authorized by the federal Job Training Partnership Act, are being suggested as governmental mechanisms for improving vocational education; but new mechanisms, I suggest, may not necessarily be better. Government should work with education to help it make reforms, but seldom does government seek reform in cooperation with education or industry. Several months ago, in one day more bills were introduced in the California Legislature than in the prior two years to reform vocational education in the Community Colleges. Since then, I've been spending at least 20 percent of my time trying to prevent the adoption of bad reforms initiated by well-intentioned lawmakers.

I am also concerned about the growing separation of funding from the basic core of the Community College system into separate "pots" of money, each with a variety of regulations and requirements. We need to fund adequately the base of occupational education; otherwise "special" funding, while helpful, will contribute to the eventual erosion of core services and resources. We cannot expect a system to improve if there is no basic funding level by which to do so.

THE NEED FOR COOPERATIVE ACTION

In sum, I support the very worthwhile goal of industry, education, and government partnership for excellence in education; but I suggest that while government can be a stimulus for the partnership, it should not act alone. In many cases, legislators are trying to reform the educational system without sitting down with educators and industrial leaders to work out good reform. And while I appreciate Dr. Levin's cautions about over optimism regarding high technology, I suggest that we do not need to be as concerned about caution as about inaction. Caution has always been the legacy of the past. High tech is certainly not the entire answer to California's economic problems, but it is part of the answer. California's educational system is not prepared to meet the needs of high tech, and action is urgently needed to make sure it does so.

WARREN J. BAKER

The economy of California, more than those of most other states, depends on a well-educated citizenry with a particular expertise in high technology.

Warren Baker, President of California Polytechnic State University, San Luis Obispo, since 1979, was previously Chief Academic Officer and Vice President of the University of Detroit. A civil engineer registered in four states, including California, he has been a National Science Foundation visiting fellow at Massachusetts Institute of Technology and has worked in research and development at the Air Force Civil Engineering Research Facility.

RECENTLY, the report of the National Commission on Excellence in Education, *A Nation at Risk: The Imperative for Educational Reform*, received a great deal of attention across the nation. It noted that, for the first time in our history, we have a generation of young people coming out of our schools less well-educated than their parents, that the quality of science and mathematics education has declined seriously, and that our overall educational standards are so low as to put us at a disadvantage when compared to other industrial nations.

To describe the educational problem in California, the title of a similar report would have to be *A State at GREAT Risk*, since the economy of California, more than those of most other states, depends on a well-educated citizenry with a particular expertise in high technology. As the president of a polytechnic university, I'd like to focus here on the part of the problem with which I have most direct acquaintance: the crisis in engineering education.

NEEDS OF ENGINEERING EDUCATION

From many sources, we find ample evidence that current engineering faculty salaries and working conditions are inadequate to attract sufficient numbers of qualified people to teach engineering:

- To upgrade the approximately 22,000 engineering faculty positions in the nation's colleges and universities would take about $80 million per year in today's dollars.

- To increase the number of faculty positions by approximately 20 percent to help offset some of the increases in student-faculty ratios that have become excessive would take approximately 4,000 more faculty positions, costing approximately $150 million per year.

- To encourage top graduates to go on to graduate school, stipends should be raised from today's level of about one-fourth to one-half the starting salary that these graduates would receive if they went into industry. If this were done for 10,000 graduate students -- about half the enrollment -- the cost would be approximately $90 million annually.

- According to estimates made by the American Society for Engineering Education, we have an unmet equipment need in the nation's engineering schools of somewhere between $750 million and $1 billion. Our facility deficit in terms of building space amounts to approximately $1 billion. If equipment is amortized over six to eight years and buildings over ten years, we accrue some $200 million more in costs each year on these facilities. This totals out to approximately $520 million for each of the next six to eight years and somewhat less after that.

To put these figures in perspective, we can compare their total of $840 million to two others: (1) the annual expenditures of corporations for university research, and (2) the annualized expenditures proposed by national planners for defense spending over the next five years.

According to the National Science Board, industry funds in the neighborhood of 6 to 7 percent of all academic research and development. This represented a sum of between $400 and $450 million in 1980-81. Hence, to ask industry to solve the crisis in engineering education by contributing to university engineering programs twice the total amount it spends on academic research and development does not seem realistic.

On the other hand, national planners are reportedly proposing expenditures of $16 hundred billion over the next five years for national defense. The $520 million annual expenditures that I have computed for engineering education represent less than two-tenths of 1 percent of these planned annual expenditures. This proposed defense effort, it should be noted, is being planned in an unprecedented manner: without a concomitant shoring up of our decaying science, mathematics, and engineering educational system. Without addressing this educational decay, the defense effort will lead to a worsening of the crisis in engineering education, as defense industries compete for the same limited technical talent as consumer and other non-defense-oriented industries.

INDUSTRIAL CONTRIBUTIONS TO ENGINEERING EDUCATION

It seems clear that the basic resources to overcome the crisis in engineering education must come from government funding. As the National Commission on Excellence in Education points out, "Of all the tools at hand, the public's support for education is the most powerful." Nonetheless, I am not for a moment suggesting that there is no role for industry in improving engineering education. I have been an advocate and a participant in university/industry partnerships for the past 20 years, and I've witnessed at least three important areas where such joint programs provide important contributions to the education of students:

- First, in many areas of high technology today, the state of the art is being pushed forward by industrial rather than academic research and development. For current and prospective faculty members to keep abreast of developments in these

fields -- resulting in more valuable faculty members and up-to-date curricula, and avoiding the dangers of faculty and curricular obsolescence -- requires that these faculty interact with industry. This has been achieved through university/industry personnel exchanges, joint hiring, and consulting, with excellent results.

- Second, industry has long been a partner in education through cooperative-education programs, in which students alternate work-study cycles. "Co-op education" provides students with an opportunity to apply on the job the principles they have learned in the classroom and generally increases their academic motivation when they return to campus from work sessions. Co-op education is especially beneficial to students who have weaknesses in their academic preparation but show the potential to succeed; it has been a motivating force in attracting minority students to high-technology programs, and it has contributed significantly to lowering the drop-out rate among engineering students.

- Third, a key component of America's strategy for innovation is university/industry partnerships for cooperation in research and development, leading to new products and technology. This kind of innovation is vital to our economic stability. As we rely less and less on our traditional smokestack industries, we will need new ideas, innovations, and new technologies to assure our continued prominence in world markets.

Despite these advantages of university/industry partnerships, one note of caution needs to be raised with respect to them: They must preserve the traditional open relationship between our universities and the larger community in which they are located by fostering freedom of inquiry and broad dissemination of knowledge and by encouraging faculty in the open pursuit of knowledge and quest for basic discoveries.

If we can avoid these potential limitations, university/industry partnerships can provide the margin of excellence that we need beyond government support to keep our engineering programs adequately staffed and up to date.

LOIS CALLAHAN

High technology sometimes seems to be more of a problem than a solution.

Lois Callahan, President of the College of San Mateo, has also served as Dean of Instruction and Director of Cooperative Education at the college. Formerly Dean of Instruction for Occupational Education at San Jose City College, she was the first woman dean of vocational education in the California Community Colleges.

FROM my perspective as president of a Community College, high technology sometimes seems to be more of a problem than a solution. Community Colleges can play an important role in education for high technology: We have facilities located throughout the State; we are accessible to everyone over age 18 through our open-door admissions policies; we have been successful in providing catch-up on learning skills and offering a second chance to students; we have made good use of industry advisory committees for curricular planning in occupational programs; and we offer a variety of versatile occupational programs, all the way from short-term training to one-year, two-year, and the first half of four-year programs. But we are faced with some dichotomies and dilemmas that we need clarified in terms of our appropriate role and mission in meeting the high-technology needs of California.

• The first concerns our responsibilities regarding what some people would term the difference between "education" and "training" or between students' needs for lifetime career development versus the needs of business and industry to fill immediate openings. I think we need to clarify what is legitimate occupational preparation at public expense. Everyone

would probably agree that general career development and occupational orientation are proper functions of the Community Colleges; but questions exist about narrowly focused job-specific training programs and, in particular, company-specific programs.

- A second dilemma concerns our dual responsibilities for youth and adults. On the one hand, we have a special role to fill in providing retraining and upgrading of adults, many of whom are in mid-career and who, having been part of the baby boom after 1945, attended school on half-day sessions, shortened sessions, and double sessions -- then went through college when the cafeteria plan was in vogue and colleges required of them few common standards. On the other hand, we must meet the needs of young people just out of high school who will come to us with better academic skills as the schools raise standards. This traditional constituency will have had little time to develop salable skills and will need career development and occupational training. Because the needs of these groups are so different, we must offer them different programs; but rather than require of them standardized programs we should retain their individual options.

- A third dilemma intermingles State and local needs. The State requires accountability for funds and commonality of policy among the Community Colleges, but at the local level we need flexibility. For example, in as diverse a State as California, rural colleges differ greatly from urban institutions; but statewide policies, ranging from tenure and collective bargaining to the "50 percent" law, limit our ability to allocate resources to meet local needs.

Beyond such dilemmas, high technology poses a variety of problems for us: It requires that we continually retrain our faculty -- and motivate them to continue to remain current in their field. It means we need more short-term faculty for short-term and occasional programs, while faculty prefer to be hired for the long term. It means trying to coordinate and simplify a variety of funding sources -- as illustrated by the fact that I am currently trying to fund high-tech programs not only through ADA but also through CWETA funds, job training funds, and industry donations, all of which have different criteria and require different paperwork. It means we must es-

tablish more clearly the competencies needed by technicians and other workers, using these competency standards in curriculum design and the development of model programs -- preferably on a statewide basis. It means we must teach students to be willing to make transitions in their careers and their lives, when we don't know much about how to do so.

Despite these problems, high tech offers us one particular advantage: It allows us to maximize the use of technology in teaching and to experiment with more effective teaching methods. Thus, at San Mateo, we have been able to develop computer video-interactive programs that are connected by microwave links to worksites throughout our district, and we operate a microwave van to provide instruction in highly specialized programs throughout our county and in neighboring locales.

In the long run, high technology will benefit our students through better instruction, by forcing us to keep up to date, and possibly by helping resolve the dilemmas that face us regarding education and training, youth and adults, and State versus local needs. But we do need help in funding high-tech programs and in clarifying our charge regarding our responsibilities for high-tech programs in light of these challenges.

HOWARD A. SLACK

Collaboration between universities and corporations in the area of basic research can work to the mutual advantage of each party and to the economic benefit of the State and country as a whole.

Howard A. Slack joined the Atlantic Richfield Company in 1965 after serving on the faculty of Northwestern University.

In 1979 he was appointed to a newly created position of Vice President for Technology at Atlantic Richfield and in 1982 became Senior Vice President for Technology, where his functions include exploration advisement, major project coordination, and health, safety, and environmental protection.

I WANT to speak out in favor of greater collaboration between universities and corporations in the area of basic research. This collaboration, which is distinct from outright gifts or grants from industry to academia, can take a number of forms:

- A partnership between an individual research professor, his or her graduate students, and an individual researcher in a private corporation in which a new technology or scientific development is being followed. Atlantic Richfield has developed a number of such partnerships, and they are working well.

- On a larger scale, support by individual companies of academic research of specific interest to them. Monsanto has agreements with Washington University in St. Louis and with Rockefeller University in New York City supporting research in the medical field. Exxon supports research on combustion at MIT. IBM has a large number of projects at universities. Each agreement is unique in its structure and is designed to fit the needs and concerns of the two partners.

- A non-profit consortium of companies in support of a particular research effort. A number of chemical companies have established the Council for Chemical Research to fund academic research and establish working relationships with universities. Another example is the Semiconductor Industry Association's support for Stanford's Center for Integrated Systems. A third involves a number of corporations that have recently funded a consortium to pool the costs and share the results of advanced computer research carried on at universities.

Such collaborations are not set up without their detractors; but with proper concern and understanding of the cultures involved, they can work to the mutual benefit of each party and to the economic benefit of the State and country as a whole.

JOHN VASCONCELLOS

The degree which we respond successfully to today's crises will be a function of the level of trust, reciprocity, faith, and collaboration we achieve between the public and private sectors.

John Vasconcellos is serving his ninth term in the California Assembly, where he chairs the Ways and Means Committee. He has served on the Assembly Education Committee and its subcommittees on educational reform and postsecondary education. His legislative district includes part of "Silicon Valley" around San Jose and Santa Clara.

TODAY we find our culture and civilization imperiled by many of the effects of man's presence on this planet for the past few thousand years. We talk about the "nuclear crisis," the "economic crisis," the "crisis in our inner cities," the "environmental crisis," and on and on -- all very real, all equally imposing, and all deserving of our urgent attention and action. Despite all these disturbing indications, however, I continue trying to offer a new kind of focus, a fresh perspective, a unique and creative vision of humanity which arises from my own sense of hopefulness about our future.

During the 1960s, the great movement in our society was the opening up of our nation's institutions to all persons -- Blacks, Hispanics, Native Americans, Asians, women, seniors, gays, the disabled -- the whole human spectrum that is our culture -- and not just Anglo males. This social revolution was in large part propelled by the premise that every single person has something special and unique to offer, that no one's talent should go unrecognized and, most important, that no one's assets or capabilities should go unutilized.

In the '70s, the great movement was to open up ourselves, our minds, and our feelings, person by person -- aiming to become

more fully integrated thinkers and feelers -- more whole, more valuing, more intuitive and competent intellectually, and more faithful about human beings and about being human. The premise of this movement was that the most effective means of solving our planet's problems was to start from the inside out; that is, to nurture the most complete actualization of each individual's healthy potential, thereby empowering those individuals to become more fully able and willing to attend collectively to the intensity and complexity of the problems facing civilization.

The movement of the '80s, which I believe both grows from and adds to the progress of the '60s and '70s, is the development of ever greater cooperation and coordination between the public sector (government) and the private sector (business).

Those in government, including those of us who are the traditional notorious "big spenders," have come to learn that we cannot spend on programs for the disenfranchised, the poor, the sick, the disabled and the oppressed, in the absence of a private sector economy that is maximally productive, vital, and expanding.

Conversely, I have had many leaders of California's business community tell me that the private sector cannot thrive without an excellent educational system, an efficient transportation system, safe and affordable housing, rational resource management, a clean environment, and other civic commitments.

The public and private sectors are now more than ever before completely interdependent. Neither one nor the other can solve the problems it faces individually, let alone the problems they face collectively, without the assistance and cooperation of the other.

The degree to which we respond successfully to the crises I highlighted at the beginning (and there are a lot more than these, believe me), will be a function of the level of trust, reciprocity, faith, and collaboration we achieve between the public and private sectors. I believe we can fuse all these values and realize this vision into a whole. When we do this, once again California will stand at the forefront of the human frontier, a proud and ever more healthy part of the world.

GARY HART

The signs are encouraging that we will once again make a strong commitment to public education and to the young people of California.

Gary Hart was first elected to the State Legislature in 1974 and served four terms in the Assembly representing Santa Barbara County. As a new member of the Senate representing portions of Los Angeles, Santa Barbara, and Ventura Counties, he chairs the Senate Education Committee and serves on five other committees, including Revenue and Taxation.

RATHER than focusing on particular issues concerning education for California's changing economy, such as the problem of attracting teachers of science and mathematics into our schools, I want to emphasize the need for improving public education across the board in California. Certainly we have a critical shortage of mathematics and science teachers; but to focus on mathematics and science and ignore history, English, and other areas of the curriculum is not an adequate response to the needs of the schools.

INCREASING FUNDS AND INSTRUCTIONAL MATERIALS

My primary priority in the Legislature is to get more money for California's schools. Governor Deukmejian proposed an increase of some $350 million this year in State support, but I do not believe this is sufficient in light of California's deteriorating rank among the states in its commitment to public education. A decade ago, California ranked very high among the 50 states in school support; but almost all studies show that in the interim it has slipped very near the bottom.

To stop this decline, my legislative colleagues and I suggested a 10 percent average increase in general appropriations to

school districts throughout the State next year. Some districts with falling enrollments would receive a smaller increase than 10 percent, while others -- including some with growing enrollments, some in rural areas with small enrollments, and those near military bases that have suffered substantial cuts in federal aid -- would receive more. We proposed that school districts be allowed to use these additional funds as they see fit: to increase teacher salaries, restore a sixth or seventh period to the school day, purchase equipment, or prevent a school from closing.

In addition to these new funds, we advocated an increase of about 25 percent in California's instructional materials account for elementary schools, which has been underfunded for the past several years. We have also proposed establishing for the first time an instructional materials account for high schools, funded initially at $10 per student. In the past, high schools have had to buy instructional materials such as textbooks and audiovisual equipment out of their general apportionments, which have suffered severe underfunding recently. Even though $10 per student is only a modest amount to help stop the deterioration of textbooks and other instructional supplies in the high schools, we are hoping that it will be a beginning for increased instructional support for high school students and that we can build upon it in future years.

INCREASING FLEXIBILITY IN PERSONNEL DECISIONS AND ATTRACTING MORE TEACHERS

Beyond these financial proposals, we proposed several changes in district personnel practices that may be of particular benefit in the teaching of mathematics and science. Beyond trying to streamline the teacher dismissal process, we proposed a limited modification in the seniority rule as it relates to classroom teachers. We don't advocate abandoning the seniority system, but instead limiting it in special cases. As you may know, when districts must cut back their staff, all too often the first to be released are young teachers, some of whom may be excellent in mathematics or science but who lack any seniority. We have suggested addressing this problem by allowing local school boards to make a finding that a particular

instructor has unique training and teaching skills and should therefore be exempt from the seniority rule. This finding could be appealed by the teachers' union or by the individual teacher who would be displaced as a result of the decision; but giving local boards such authority would allow some flexibility to retain gifted young teachers, and is more acceptable to the teachers' unions than doing away entirely with the seniority rule.

To reduce the problem of reassigning unprepared teachers from other subjects, such as driver training or physical education, to teach mathematics or science, we also suggested that any teacher who is transferred from one subject-matter area to another and who has never studied the new subject in depth must pass a subject-matter proficiency examination. We feel that this requirement will help safeguard against the inappropriate redirection of faculty members who may be expert in a subject but not prepared to teach in a critical need area.

I doubt that I have to cite the statistics about the small number of talented college students who are entering the teaching profession, but I will point out one fact that illustrates the problem: A survey of entering freshmen at Stanford revealed that out of a class of 1,200 or more, only two indicated that teaching was their career choice. I don't know if the Legislature can turn this problem around in a short period of time and make education a more attractive profession; but there are some steps that we can take in this direction.

- One step is to increase the minimum teacher's salary in California from its present low of between $11,000 and $13,000. We suggested in our legislation that the minimum salary be increased over a four-year period to $18,000. We believe that if we can send a message out now to college freshmen, sophomores, and juniors that four years from now they can expect to earn at least $18,000 as a beginning teacher, a teaching career will be more attractive.

- Another step is to improve working conditions -- in particular, teachers' rights regarding student discipline. We are trying to send out a message that teachers do not need to tolerate disruptive or violent students in their classrooms and

that such students will not be allowed to disturb the learning environment.

- A third step involves the status of teaching, which in many ways is even more important than salaries. Even superb teachers have never expected to get rich in the teaching profession, but they have rightly expected to be respected and to have their work honored in some way. It is in this area of status that I think the business community can play a special role by giving opportunities for elementary and secondary school teachers to get out of the classroom occasionally and interact with colleagues in the private sector. There may be other ways of honoring teachers who have distinguished themselves through outstanding service, beyond just a luncheon once a year or an article about them in the newspaper. I'm not sure what these mechanisms might be, but we need suggestions that would help to send a better message about teaching to prospective teachers.

INCREASING GRADUATION REQUIREMENTS

The final proposal for upgrading California's schools involves strengthening academic standards by re-establishing course of study requirements for high school graduation. California used to have course requirements for graduation, but since the late 1960s, we have had no statewide requirements. In school districts that have given total discretion to students as to the classes they take, many students have taken advantage of pleasant electives rather than focusing on basic skills that are essential for good citizenship and steady employment. What we are proposing for high school graduation is three years of English, three years of social studies, two years of mathematics, two years of science, and one year of fine arts. Personally, I also favor a requirement that high school graduates have some familiarity with computers, but this idea has raised so many questions among some of my legislative colleagues in terms of cost and specificity that we did not include it in our legislation.

In response to concerns expressed by members of the Legislature and educators about the relevance of graduation requirements for students who do not plan to attend college, we

developed language that would require the State Board of Education, in consultation with the Superintendent of Public Instruction, to specify continuums of skills in English, mathematics, and science that are appropriate for non-college-bound students as well as ones for potential college students. We expect all students to develop the competencies appropriate for them.

We hope that by specifying these skills or competencies, the Board of Education and the Superintendent of Public Instruction will establish a standard that will prevent schools from merely renaming or reclassifying existing courses to meet the new graduation requirements, even if the courses lack the substance that we would expect of them. We also hope that by emphasizing these competencies rather than traditional "subject matter" as such, the requirements will encourage teachers and districts to develop interdisciplinary approaches in these courses rather than feeling bound to offer traditional discipline-bound courses. As you may know, many pressing social and scientific problems, such as environmental issues, are not adequately addressed by traditional disciplinary courses; and we would not want the new graduation requirements to be interpreted as restricting approaches to the disciplines, or limiting the emerging renaissance in curriculum development. I believe we made progress during the Sputnik era in updating the science curriculum, but since then the curriculum seems to have unnecessarily solidified. We hope in the future to keep the curriculum more continuously up to date.

ASSURING EDUCATIONAL REFORM

In the past, the principal legislative stumbling block to major reforms in education has been the Senate rather than the Assembly, but I am increasingly hopeful that both houses will continue to support legislation such as we have submitted. Given the increased public concern, the attention of the media, the influence at the federal level of the National Commission on Excellence in Education, and the support of educators and the business community, the signs are encouraging that we will once again make a strong commitment to public education and to the young people of California.

WILLIAM LEONARD

We cannot improve the quality of job preparation, private enterprise, the quality of life of our citizens and others, or America's strength in both high technology and mass production without quality in secondary education.

William Leonard was elected to the State Assembly in 1978. He currently represents the 61st District of San Bernardino County. In 1982, he was appointed the Assembly Republican Caucus Whip. He is Vice-Chair of the Assembly Ways and Means Committee and serves on the Health and Utilities and Commerce Committee.

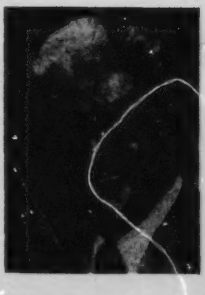
FOR three years, I served on the Education Subcommittee of the Assembly Ways and Means Committee, and I now serve as vice chairman of the Ways and Means Committee. I have a great interest in education from that professional viewpoint as well as from a personal viewpoint as a product of California schools and as a parent. The improvement of elementary and secondary education in California is the most interesting, provocative, and important subject facing us, because it deals both with employment preparation and with the role of post-secondary education, since the quality of our high school graduates affects the quality of our colleges and universities.

With a few notable exceptions, businesses have not been involved adequately in the secondary education process during my experience in the Legislature. I am encouraged, however, by the current growth of interest by business in the educational enterprise, since there is a definite and dependent link between economic development and education. We cannot improve the quality of job preparation, private enterprise, the

quality of life of our citizens and others, or America's strength in both high technology and mass production without quality in secondary education. Industry involvement is needed in developing the standards of what should be considered competency as a high school graduate enters the job market or postsecondary education. I agree with John Young that the role of secondary schools is not just to develop productive workers but also to develop whole individuals -- citizens of the world, if you like. That role will not be diminished, however, by enhancing the employment opportunities and thus the economic opportunities and prospects of high school graduates, and business has a very definite responsibility here for involvement in education.

Like business, postsecondary education has not been closely involved in secondary education in recent years, despite the inextricably circular relationship between universities that train teachers for the schools and the elementary and secondary schools that prepare youngsters for, among other paths, the universities. It is very important that representatives of postsecondary institutions be involved in the secondary education process, since colleges and universities are being blamed for some of the problems of the secondary schools, and they are having to deal with deficiencies stemming from problems in the schools. Here, too, I am encouraged by increased acceptance of this responsibility on the part of college and university leaders.

RICHARD COLLINS



I enthusiastically endorse MESA to industry, government, and education as one way that has been proven successful in improving high school education for minority students interested in engineering, science, or math-based careers.

Richard Collins is Vice President of Bechtel Power Corporation and manager of Bechtel Power Management. Registered in seven states as an engineer, he is a Fellow of the American Society of Civil Engineers, a Regent of the University of Santa Clara, a member of the Industrial Advisory Council of the California State University, and Vice Chairman of the Board of Directors of MESA.

THE THEME of this book is education for California's changing economy and more specifically high technology. It contains concerns about quality education, particularly for our growing minority population. It also contains ideas about improving the partnership of the educational and industrial communities.

I want to tell you a success story that encompasses these three areas, and that is the story about MESA (Mathematics, Engineering, Science Achievement). MESA was started at the University of California, Berkeley, in 1970, to encourage minority young people to take the courses they need in high school as a basis for progressing into math-based programs as university students and into engineering, scientific, and related management jobs in our industrial society: jobs in which minorities continue to be sorely underrepresented.

The basic concept of MESA is to identify early in high school those minority students who may have an interest in pursuing a math-based career and then to work with them during high school so that they complete three or four years of mathematics, science, and English in order to retain the option of majoring in math-based fields of study as university undergraduates. Today, MESA is operating in over 140 high schools in four states -- California, Colorado, New Mexico, and Washington. Each MESA center includes in its program such activities as academic and career counseling, summer enrichment programs and employment, study-group sessions, computer workshops, special career activities and speakers, mathematics and science contests, incentive awards for high grades, parent meetings, and field trips to industrial firms that support MESA and to other sites. Participating in these activities builds a sense of community among students. They start to feel part of a group and develop pride in themselves as well as the group, as they see that professionals from industry, universities, government agencies, and professional societies are interested in their academic performance and their future.

Currently, 4,000 students are participating in MESA, and more than 800 of them will graduate from high school this year. As in the past four years, we expect that over half of them will pursue math-based fields of study as university students. In fact, 78 percent of last year's MESA graduates in California went into such fields.

Briefly, I would like to comment on why I believe MESA offers a successful strategy for helping prepare students to enter these fields:

- First, it has a clear goal -- improving student performance and persistence in courses that lead to options for students in math-based fields -- and this goal is related to filling important needs in our society: the need of our universities for well-prepared students, the need of our industries for well-trained employees, and the need of our country at large for skilled professionals from all backgrounds and, in particular, from those groups that have often in the past been neglected in programs for college-bound students interested in professional careers.

- Second, MESA works within the existing educational structure, rather than outside it. Its volunteers from industry and universities work with school teachers and principals to build on what is available in the schools and to add what the schools need in the form of other programs and services. This is why teachers and principals support MESA: It recognizes their importance while offering them a means of meeting their aspirations for all their students.

- Third, MESA involves the parents of students in its activities. Parents lend their support to the efforts of teachers and MESA volunteers, and thus play an essential role in encouraging their youngsters' academic progress.

- Fourth, as a bottom-line results-oriented program, MESA is cost effective. I think this is why it is particularly attractive to industry, which views many programs as "let's throw money at the problem" bureaucratic operations. In order to make sure we get "a bang for our buck," we track MESA students during high school to see if, how, and when they get into a university. Investing a modest $300 to $400 per student each year buys services that increase the number of students taking advanced high school mathematics and science courses, improve their performance in these courses, and raise their percentage of matriculation in math-based fields of study as university undergraduates. In a few high schools, where MESA has not been getting results or has not received the cooperation of the principal and teachers, it has pragmatically closed down its program. On the other hand, in schools where improvement is dramatic, it increases its investment in order to add additional students to the program.

- Fifth, because of its businesslike, bottom-line approach, MESA has found an effective way to have industry, professional societies, and other organizations help the schools Beyond financial contributions from them, it gets volunteer time of their people to serve as role models for students. To have engineers from a spectrum of companies meet with young people, explain their work, and show them some of the romance and intrigue of engineering helps young people understand

what an engineer really does and see that they, too, can aspire to that role.

- Sixth, MESA provides each of its centers with the flexibility that allows for local ownership and responsibility by the people who are doing the work. Its statewide offices seek support, set general goals, and determine budgets, but each local center allocates resources, identifies opportunities for students, designs activities that are appropriate to the local environment, and is responsible for results. As a consequence, local teachers, corporate and faculty volunteers, parents, and students feel that MESA is their program, and they make it work.

These features have thus far led over 30 engineering and high-technology firms in California to support MESA financially, and each year these firms like what they see better and better. Their contributions have, in turn, generated significant State resources, leading this past year to a doubling of both private and public support. As a result, MESA is not only continuing to expand its secondary school program but is initiating what we hope will be a very successful new "retention program" at the university level. Like others involved in minority education throughout the nation, we have found that even if you get minority youngsters prepared for university admission and to compete in the university environment, in many instances, they still encounter "culture shock" when they arrive at the university. To succeed in the university, these students need additional encouragement and support such as study groups. By providing this assistance in the "retention program," we think MESA will further improve the graduation rates of MESA students at the university level.

Because of these features, I enthusiastically endorse MESA to industry, government, and education as one way that has proven successful in improving high school education for minority students interested in engineering, science, or math-based careers.

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MICHAEL KIRST

There is a lot we can do to improve the curriculum by carefully rethinking our approach. Although we need much more money for the schools, some high-leverage items won't cost a great deal.

Michael Kirst is Professor of Education and Business Administration at Stanford University. He has served as President of the California State Board of Education, as Staff Director of the United States Senate Committee on Manpower, and on the Executive Advisory Staff of the California Commission on Industrial Innovation.

WHEN we talk about the need to raise standards in elementary and secondary education and to educate students so they can be adaptable regardless of their career choices, one concept that is often overlooked is that of "higher order thinking skills." To the extent that social, economic, and career change calls for tomorrow's adults to be flexible and adaptive, learning these higher order thinking skills will be particularly important -- more important, for example, than the years of schooling or the number of courses that they complete.

What are these higher order thinking skills? They involve such things in mathematics as estimating and problem solving -- having "a feel for numbers" -- rather than rote computation. In English they involve systemic analysis, such as taking a complex piece of literature, understanding the tone and approach of the author, and writing more than a paragraph about it. (According to one national survey, only 3 percent of the school time of students is spent on writing anything more than a paragraph, writing simple sentences, or filling in blanks with words.)

TESTS AND TEXTBOOKS

We have not been doing a particularly strong job in developing these kinds of general intellectual skills. In some ways, it is unfair to blame the schools for this problem. Instead, we should take a look at State policy and, in particular, at the California Assessment Program -- our statewide testing program mandated by the Legislature to measure students' academic achievement in school. This testing program neglects problem solving and systematic analysis in favor of rote computation and factual recall. My first suggestion, then, for adapting California education to the changing economy of the State is to throw out the current California Assessment Program (CAP) tests and introduce tests that stress these higher order skills. Our CAP math tests overstress computation and neglect problem solving.

My second suggestion is to align these new tests directly to the curriculum that we teach and the topics we actually cover in the classroom. The California Assessment Program is not related to the course of study in the schools (that is, to State Curricular Frameworks), or to the textbooks that the State adopts for this course of study -- and they cannot be aligned to it. So the new test should measure the basic skills that we teach and that we think are needed for California's changing economy and society.

Third, the textbooks adopted by the State are not tied to our curricular goals or to State Curricular Frameworks. I would realign the entire textbook-adoption, curriculum building, and testing system so that it is unified. This process of linking textbooks and new tests of high-order intellectual skills to the high school curriculum would begin to get us on the track of where we really need to be. It would go farther, however, than Senator Hart's proposals and those of most others currently before the Legislature, which would primarily involve changes in course requirements and could in my opinion be easily evaded as a result.

TESTING AND STATE SCHOLARSHIPS

If we want to go still further along this track, my fourth suggestion is for California to emulate the State of New York and

its Regents Examinations, which the New York State Education Department administers in various fields such as English, history, and biology. In my observation, New York has held its high school achievement levels higher on a statewide average than most other states, in part because these examinations are clearly linked to the school curriculum and to the award of New York State Regents' scholarships to college. In California, we should create a similar Regents Examination program and link college financial awards through our Cal Grant program to how well students score on these examinations. In the California Assessment Program, we do not test for what students have learned in English, history, biology, or other fields, and we do not use students' scores in this program for awarding college Cal Grants. Tying high school testing and teaching to the rewards and incentives of the higher education grant system would be a very powerful lever for change.

STATE UNIVERSITY ADMISSIONS REQUIREMENTS AND HIGH SCHOOL CURRICULAR REFORMS

The fourth lever, which we in California have worked on already, is strengthened college admissions. I think this ball is now in the California State University's court, and they need to take more action. We have talked much about science and about the need of California citizens to learn more science, but the State University has no requirement of science in its admission policy. It seems to me that this is an issue that the faculty, Academic Senate, administration, and Trustees of the State University should discuss in order to adapt education to California's changing economy.

Fifth on my list would be improving the so-called "general track" curriculum in the State's public high schools. At Stanford, we found in a study of transcripts from 28 high schools across the State that inadequate sequence and cohesion exists in programs not among those students planning to attend selective colleges or among those who are doing really poorly in their courses but, instead, among the large middle group of students -- those who are likely to attend Community Colleges or go into the labor market. We found that few mathematics and science courses exist in the eleventh and twelfth grades

for these students to take, unless they take university-track courses of trigonometry and calculus in mathematics or physics and chemistry in science. This is one reason why the course of study of so many students looks chaotic -- filled with jewelry making, child development, and other "soft" courses. These middle-track students lack the cues or incentive to elect a curriculum that provides cohesion and depth.

Sixth, I would argue that although our comprehensive high schools have tried to finish vocational skill training by the end of the twelfth grade for those students who plan to enter the labor force immediately on graduation, they cannot do an adequate job of this task in the foreseeable future, despite the improvements that Senator Hart and others have urged in the high school curriculum. I think we are kidding ourselves that we are going to have the money, the manpower, or the machinery to offer finished vocational skill training by the end of the twelfth grade in each comprehensive high school in the State. Therefore, I suggest we give up this fiction, turn vocational skill training primarily over to regional occupation centers and Community Colleges, and make "vocational" programs in high schools essentially vocational awareness and exploration programs. This would also free up school resources for their more general academic programs.

HISPANIC STUDENTS, COMPUTERS, MATHEMATICS, AND SCHOOL FINANCE

My seventh issue concerns the education of Hispanic youngsters. We have made good progress in helping many minority children, but we have made very little progress with Hispanic children -- and there are no proposals currently before the Legislature to do anything about it. We are totally stalemated in Sacramento by the fact that whenever we discuss this issue, we get into a philosophical shootout over bilingual education for kids aged five to eleven. We have rarely even discussed what to do to help Hispanic junior high and high school students. Our colleges and universities are worried about these students but have few programs to help them. I would skirt the historic arguments over bilingual education, and focus first on improving secondary school for Hispanic students and only after that turn to their elementary schooling.

Eighth, I would rethink the role of computers in education. Somehow we have gotten the idea that computers in the schools are related largely, if not entirely, to teaching mathematics and science. For example, at one high school I visited recently, students cannot enroll in the computer programming class until they have had geometry. What a bunch of nonsense! Computers are used not only in mathematics and science; they are helpful in a wide range of data analysis problems -- from computer graphics to word processing and helping students write better; and we should use them there.

Ninth, we should add into the high school mathematics curriculum much more about probability and statistics, which are now taught only in college. I believe that the essentials of trigonometry -- sines and cosines -- could be taught in three weeks of the typical high school trigonometry course, and I would turn the rest of the time over to probability and statistics.

Tenth and finally, we in California should remember that we are one of only two states in the country that has assumed full state support of school financing. The other state is Hawaii, which perhaps not incidentally was once a kingdom. No local options remain for financing California's schools. Senator Gary Hart has proposed local tax options of up to 5 percent of the statewide average of general apportionments for the schools; and earlier this year, the city, county, and school district officials sought to launch an initiative that would turn back to local authorities large amounts of State taxes and give them some flexibility in their use. I would like to see that initiative qualify for the ballot and pass, because I believe that until then, State officials in Sacramento are going to be happy to run education all by themselves.

In other words, my theme is that there is a lot we can do to improve the curriculum by carefully rethinking our approach. Although we need much more money for the schools, some high leverage items won't cost a great deal.

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STEVE WEINER

If we do not assume our own individual responsibility for school reform, the only people we will have to blame for the failure of our schools are ourselves.

Steve Weiner became Provost and Dean of Faculty at Mills College in July. Previously he was Special Assistant to the Vice President of the University of California. The former President of the Board of Governors of the California Community Colleges, he chaired the legislatively authorized Student Financial Aid Policy Study Group and directed the California Education Seminar.

AS A representative of public higher education -- at least for a few more days before moving to Mills College -- I am glad to be able to say that California's colleges and universities have been far more active on issues of school improvement at the elementary and secondary level in the past few years than they were previously. MESA, the California Writing Project, the California Mathematics Project, the Joint Mathematics Diagnostic Testing Project, the new higher admission standards at both of our public universities -- all of these efforts illustrate this activity. In addition to these statewide programs, individual campuses are conducting programs, such as those at the Lawrence Hall of Science in Berkeley.

Beyond these efforts, the California Round Table on Educational Opportunity, which involves the chief executive officers of the various segments of education in California, including Pat Callan, representing the Postsecondary Commission, and Art Hughes, representing the independent colleges and universities, has within the last year distributed a most significant statement written by the Academic Senates.

This statement, for the first time in the history of California, tells high school teachers precisely what skills their students will need in mathematics and English composition in order to succeed in college. The Round Table has also recently prepared and distributed to eighth grade students, throughout the State, a document describing the kinds of courses they should consider taking in high school.

Although it would be tempting to go on in this fashion to congratulate people in higher education on their work for school children, I want to emphasize what should be on the top of our agenda in the immediate future, rather than dwell on what we have done in the past.

INCREASING PROFESSIONALISM

The first issue is recognizing the centrality of good teaching in the school improvement process. Without better teachers, imposing new graduation requirements or tying testing to textbooks to instruction will not make much difference. Higher salaries are necessary but, by themselves, not a sufficient condition for strengthening the teaching corps in California. Talented young people, particularly talented women who now have career options undreamt of just a few years ago, will not be attracted into teaching unless teaching becomes closer to a profession than it is now. This involves much more than money.

- It involves giving greater responsibility to teachers in making curricular and textbook decisions.

- It means providing career growth within teaching rather than forcing teachers to become administrators or union officials in order to progress in their careers.

- It means providing a place for outstanding teachers in the preparation of other teachers.

- It means more respect for teachers from administrators, school board members, students, parents, and the media.

- It means provision of opportunities for professional development which are decisively shaped by teachers themselves.

- And it means that teachers should devise and run a merit system involving their own colleagues.

I suggest that if we are to address these questions of making teaching a profession, we are going to have to do more than pass a law. Teachers, individually and collectively, and educational institutions at all levels will have to contemplate radical changes in the way we do business. I use the term "radical" deliberately, because I honestly believe that unlike many other public policy areas, we have come to a point in terms of the crisis in the teaching profession where incremental change will not make much of a difference.

HELPING MINORITY STUDENTS

The second neglected issue concerns the impact of contemplated reforms on poor and minority children in California. Many people have said, I among them, that higher expectations and higher demands for student performance will benefit all children. I believe that high expectations are especially important for poor and minority children who often find themselves in educational environments where there is virtually no expectation that they will accomplish anything.

But there is grave danger in smugly dismissing the question of the impact of new reforms on children of poverty and children of color with this well-intentioned assurance. What students learn and the aspirations they come to hold depend on a fiercely complex web of circumstances, including the culture of their home and their peer group as well as the relationships between their school and their community and the teacher and the student. Can we say with confidence that we have mastered, for example, the exquisitely difficult challenge of educating Hispanic children (especially those with limited or nonexistence skills in the English language)? Such confidence is not warranted, not only because we do not have the requisite personnel or teaching strategies, but also because we lack an intelligent and reasoned discussion of the issues. Let us be frank -- we have largely abandoned our efforts to integrate our

schools beyond mixing ethnic groups to a degree already inherent in our largely segregated housing pattern. What stategy do we have to replace integration? At the moment, my impression is that we have none.

Thus I join in celebrating higher admission standards enacted by our universities, and I join in applauding the reforms and extra funding that are now being proposed for the schools, but I suggest that unless these seeds of discontent are addressed, the harvest that we realize from reforms will be severely disappointing. If we rest on the laurels of whatever the Legislature can accomplish this year, and if we do not address these tougher issues of upgrading teacher quality and addressing the education of poor and minority children, four or five years from now the Legislature will be holding hearings as to why we didn't get better results after putting all the new money into the schools.

My fundamental message is that there is a grave danger that we will assume that school improvement is all the Legislature's problem and that the Legislature will deal with it. I suggest that the Legislature can make a very important contribution, but it cannot do the entire job. The tasks of upgrading quality and educating minority children involve the business community, the mass media, civic leaders, teachers, administrators, and our universities. For example, in the past we have not used our university schools of education well to construct enduring and productive relationships with the schools. They can be far more effective than they have been. The University of California has a particularly important role to play here. Despite the many individual faculty and staff members within the University who have worked so hard to improve the schools, we should candidly acknowledge that the University as a whole has barely begun to meet its responsibility to the children of California. But if we do not assume our own individual responsibility for school reform, the only people we will have to blame for the failure of our schools are ourselves.

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APPENDIX

Strategies for Increasing High-Technology Manpower in the West

The following list of strategies is reproduced from pages 10-44 of *High-Technology Manpower in the West: Strategies for Action*, a report of the Western Interstate Commission for Higher Education (Boulder, Colorado, January 1983).

MANPOWER PLANNING

1. Build a statewide and interstate system of manpower planning that focuses on coordination of information between educational institutions, industry, and government.
2. Develop state and/or institutional policies that guide the process of internal reallocation of resources at colleges and universities in line with state and regional manpower planning efforts.
3. Establish cooperative manpower planning efforts, including research projects, that address manpower issues of common concern within states and the region:
   a. Establish a common system of classification in high-technology fields that can be used by industry, states, and educational institutions in future manpower planning activities;
   b. Develop appropriate data bases and analytic methods to project state and regional supply and demand in high-technology fields;
   c. Conduct regional studies of the long-term nature of supply of high-technology skilled workers, technicians, and professionals, examining particularly defects in the pipeline; for example, the training of minorities, re-

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lationship of transfer and retraining programs, skills of two- and four-year level trained people.

DESIGN AND QUALITY OF PROGRAMS

4. Create flexible, responsive curricula in high-technology fields by developing new programs in response to technological growth, while phasing out or reducing programs declining in current application.

5. Improve intrastate and interstate transferability of credits in high-demand fields to expand student access to quality programming in specialties at other institutions.

6. Establish and make effective use of advisory councils composed of industry and educational representatives to review the design and delivery systems of educational programs at two-, four-year, and graduate school levels in light of industry needs and quality. As part of review activities, councils should address manpower and needs assessments as well as internship and on-the-job training experiences.

7. Improve teaching in high-demand fields through the use of new instructional techniques.

8. Conduct studies of the adequacy of training provided to students at two-, four-year, and graduate school levels and use results to improv educational programs at institutions.

9. Raise college and university entrance requirements for math, science, and English in order to induce schools to better prepare students at the high school level for future technological careers.

10. Better inform students, parents, and teachers about the importance of early preparation and solid background in mathematics, science, and English for future careers in technological fields and preparation for effective citizenship in a technological society. Efforts might include:

a. Information programs for students and parents at the elementary and secondary school levels;

b. In-service programs for teachers;

c. In-service programs for school counselors to more effectively carry out their career guidance roles, with particular emphasis on interpreting labor demand studies and analysis of governmental manpower reports;

d. Informational programs to raise the level of technological literacy among the community at large.

11. Make pubic school teaching more attractive; for example, through loan forgiveness programs for students who agree to teach mathematics and science, special state income tax credits for K-12 teachers in high-demand fields, special recognition to reward excellence in mathematics and science teaching, and differential salaries for fields in short supply and for high-quality teachers.

12. Examine state certification procedures for teachers in mathematics and science and raise standards where teachers are being certified without proper qualifications. Implement competency-based evaluations of science and mathematics teachers to determine what in-service education is needed and provide programs to upgrade teacher skills.

13. Establish a statewide task force composed of leaders from postsecondary education, state offices, and industry to work with established educational agencies, such as the state department of education, to develop guidelines for use by schools in expanding and improving mathematics and science curricula.

14. Provide equipment through donations to elementary and secondary school mathematics and science programs; facilitate access to updated equipment through field trips, sharing of resources, cooperative projects, etc.

15. Improve the pool of students training in careers in science and mathematics teaching by raising the

admissions standards for students wishing to become K-12 mathematics and science teachers.

16. Make effective use of industry staff, postsecondary education institution faculty, and advanced-level undergraduate and graduate students to serve as teachers for advanced science and mathematics classes in secondary schools; this could include shared appointments, teaching assistantships for students, industry loans, etc.

17. Establish specialized academic year schools or summer institutes within school districts and/or statewide to provide top mathematics and science students with a quality college preparatory program; send top students to local community colleges or universities at reduced rates to take advanced mathematics and science courses.

ACCESS OF MINORITIES AND WOMEN

18. Sustain and expand efforts to recruit and retain minority and women students of merit in high-technology education programs at the two-, four-year, and graduate school levels through:

    a. Provision of information and counseling programs;

    b. Provision of financial assistance programs on a state and regional basis;

    c. Expansion of the Western Name Exchange (consortium recruitment network) administered by WICHE;

    d. A regional resource center to provide services such as workshops on career opportunities, summer training programs for high school graduates and undergraduates, information referral and counseling, studies on access, special programs for retraining liberal arts undergraduates, networking with national efforts, networking with colleges and universities not participating in national efforts, special services to community colleges, etc.

19. Improve the articulation and transfer between science and mathematics programs in two- and four-year postsecondary educational institutions.

SUPPLY OF GRADUATE STUDENTS

20. Establish effective recruitment and incentive programs to attract and retain students in doctoral-level study in high-demand fields through:

    a. Early identification and recruitment of students interested in teaching careers;

    b. Scholarship, assistantship, and fellowship funds, with stipends based on a standard regulated by the baccalaureate's outgoing salary;

    c. Loan forgiveness programs with repayment through service as faculty;

    d. Industrial assistantships or internships (with commitment of shared appointment with industry and education following graduation) for advanced-level students to provide experience and financial support;

    e. Establishing regional programs in specialty areas as part of the WICHE Graduate Education Program so that students can attend programs at in-state tuition rates and take advantage of specialties not available in their own states.

21. Provide ways that top foreign nationals with graduate degrees in high-demand fields can remain in the United States after graduation by:

    a. Establishing clear governmental and institutional policies affecting the admission of foreign nationals to high-demand fields in colleges and universities.

    b. Conducting early identification of top doctorally prepared students for possible faculty positions in high-demand fields and providing teaching assistantships (with provision for payback through faculty service) to assist students in developing effective teaching skills and language proficiency.

22. Establish more part-time graduate programs (particularly offering evening and weekend classes and videotape instruction) to make it possible for engineers and scientists employed full time in industry to study for the master's and doctorate degrees.

SUPPLY AND DEMAND FOR FACULTY

23. Expand efforts to recruit and retain top faculty members in high-demand fields by providing higher salaries through:
    a. Establishing differential pay scales;
    b. Providing "enrichment" of salaries on an ad hoc basis through corporate contributions;
    c. Establishing shared appointments between educational institutions and industry to provide enhanced salaries;
    d. Establishing program differential pricing -- tuition differentials -- with increased funds allocated to faculty salaries.
24. Expand efforts to recruit and retain top faculty members in high-demand fields by providing better working conditions through:
    a. Establishing shared appointments between educational institutions and industry to provide new opportunities for research;
    b. Establishing research funds through industry, state government, and institutional contributions to encourage faculty to undertake significant research, particularly applied problem-solving projects;
    c. Setting faculty workloads at reasonable levels through enrollment limits where expansion of programs has taxed faculty resources;
    d. Providing increased staff support through graduate assistantships, technicians, and other support staff.

25. Establish a statewide and/or regional industry loan program in which companies make employees -- regular and retiring -- available to colleges and universities as faculty in high-demand fields.

EQUIPMENT AND FACILITIES

26. Modernize instructional and research equipment and facilities to increase the capacity of colleges and universities to provide quality training to students and provide enhanced research opportunities; provide adequate resources in institutional budgets to house, operate, and maintain equipment.

27. Provide new federal and state tax incentives to industry for donations of state-of-the-art equipment and maintenance and operations assistance to educational institutions.

28. Establish shared laboratory facilities between industry and postsecondary education institutions, between two- and four-year institutions, and between like-level postsecondary education institutions to share facilities and equipment resources. Establish regional centers of excellence in high-demand specialties, wherein states and industry share the costs for maintaining top-quality equipment and facilities.

29. Identify new financing programs to enable institutions to purchase state-of-the-art equipment.

30. Make better use of available high-technology facilities and equipment in colleges and universities, particularly during the summer months, for special programs such as K-12 teacher in-service, upgrading programs for college teachers and industry employees, high school student early identification programs, etc.

31. Establish a clearinghouse on a statewide or regional level to identify equipment available within industry and equipment needs of educational institutions to facilitate more effective matches of equipment donations.

CONTINUING EDUCATION AND TRAINING PROGRAMS

32. Establish state policies and statewide and/or regional networks of colleges and universities within and across state lines to make quality continuing education programs -- both upgrading and degree programs -- in high-technology fields more widely and cost-effectively available. Special activities might include:

    a. Regional interconnect network to allow broad-based delivery of programs;

    b. Task force to assess the need for "external degree" programs that could be developed by a consortium of colleges and universities;

    c. Coordinated effort to catalog and evaluate programs available in the West;

    d. Identification and brokering of new training needs in the region;

    e. Guidelines on developing quality programs for curriculum developers.

33. Establish training programs for unemployed groups with good potential for entry into high-technology-related employment.

34. Develop effective policies and programs in the two-year college system for retraining and upgrading faculty skills in high-technology fields.